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# Refining thoracoscopic left S3 segmentectomy by a unidirectional approach

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Thoracoscopic anatomical lung resection is today an integral part of the armamentarium of specialized thoracic tertiary referral centers. It is evident that patients benefit from a thoracoscopic approach in the form of a shorter hospital stay, less pain, improved cosmesis, better pulmonary toilet and increased tolerance of postoperative chemotherapy when compared to an open approach (1). While thoracoscopic lobectomy can be considered as a standard procedure, minimally invasive segmentectomy is technically more challenging and demanding, and this procedure is usually reserved for expert centers that have high volume and high expertise video-assisted thoracoscopic surgery programs. Indications for a thoracoscopic segmentectomy are, beside various benign lesions, small peripheral malignant tumors which are less than 2 cm in diameter and in patients with a limited pulmonary reserve. In well trained and experienced hands, thoracoscopic segmentectomy offers equivalent oncological outcomes when compared to thoracoscopic lobectomy in terms of the incidence of local recurrence and long-term survival in stage IA non-small cell lung carcinoma (2).

Segment (S) 3 belongs to those segments that are rather less common resected, particularly on the left side (3,4). In case of an early lung cancer within the upper lobe, most centers prefer to perform an upper lobectomy on the right side, or a trisegmentectomy on the left side. When considering a segmentectomy of S3, a precise knowledge of the anatomy, particularly of the distant arterio-venous-bronchial structures is mandatory. The superior pulmonary vein usually receives drainages from the apicoposterior vein and from the anterior (S3) vein which again consists

of three branches, the superior, inferior and posterior vein. In contrast to the right side where the pulmonary artery runs continuously anteriorly of the bronchial tree, the left pulmonary artery crosses the left main bronchus anteriorly but is then located posteriorly in relation to the upper lobe bronchus and becomes anteriorly again when it enters the fissure. While the venous tree is well prepared from the hilum, many thoracic surgeons chose to identify the pulmonary artery to S3 from the fissure. Usually, the preparation for a resection is then continued by opening the posterior pleura followed by preparing the fissure. Here, the branches of the pulmonary artery including the superior branch to the lower lobe, the lingula artery and the artery to the apicoposterior part of the upper lobe can be well identified. Also, the bronchus to S3 is best exposed from within the fissure, that is from the posterior prospective.

Quite different from this technique, Zhu and colleagues present in their study in *Annals of Translational Medicine (ATM)* an approach to S3 in which they prepare all structures, the vein, the artery, and also the bronchus from the ventral side. They did so to avoid manipulation of the lobe by turning it multiple times during the preparation process, but also to better identify the intersegmental plane. Authors did not provide a detailed description including tricks and pitfalls of this unilateral approach which would have been most helpful to the reader. Instead, they provide an elaborated video that has a good educational value, not only for the learning generation of thoracic surgeons but also for the more experienced colleagues. Particularly dividing the bronchus of S3 also from anteriorly as Zhu and colleagues suggest seems reasonable as the bronchial

tree runs anteriorly to the pulmonary artery down to the level of the fissure, being aware that the anterior bronchus is one of the deepest structures at the level of the fissure, heading away from the surgeon. In order to differentiate the branches of the upper lobe bronchus, a good landmark is the intersegmental lymph node No. 12 that serves as a marking point for the border between lingula bronchus and the upper division bronchi thus facilitating the identification of the bronchial branches.

Another obstacle of the resection of a segment, not only in the thoracoscopic but also in the open form, is the existence of variations. The artery to the left S3 normally originates from the left truncus anterior as the lowermost artery. However, the artery to S3 can also rise close to the lingula artery or even forms a common trunk with the lingula artery. As a variation, a mediastinal lingula artery can exist which occurs in 18% of cases and is considered an accessory artery to the lingula segment (5). This artery should be particularly searched for in the presence of a thin lingula artery. A valuable tool to learn about and study the exact anatomy in detail prior to thoracoscopic lung resection is a 3-dimensional modelisation in which the tree of the veins, arteries and bronchi can be nicely displayed. Gossot and colleagues have recently published an elaborated study on this topic deciphering the anatomy and some variations of the arterio-venous and bronchial tree (5). In the presence of a mediastinal artery, the dissection of the truncus anterior should be conducted carefully as the mediastinal artery runs anteriorly between the vein and the upper lobe bronchial trunk being in close contact to the bronchus.

With regard to the venous drainage, variations are also not uncommon. All three segments, S1-3, of the upper lobe, can form a common trunk or can form a separate vein as S3 being the lowermost branch. In case the lingula veins are thin, it seems advisable to spare the inferior branch of the S3 vein.

One of the main differences to thoracoscopic segmentectomy is the difficulty to clearly identify the intersegmental border which is normally defined by the intersegmental-running veins marking the segmental boundaries. The open fracture technique allows for blunt but at the same time blind digital dissection. In some centers, this has been replaced by precision cautery dissection or more often by stapler-assisted dissection. For defining the intersegmental border, Zhu and colleagues chose to apply gentle reventilation of the bronchus to S3 thus identifying the segment, a method that is widely accepted by thoracic surgeons. However, this technique

has the disadvantage to be sometimes inaccurate due to collateral ventilation from the remaining lobe. Newer techniques, such as near-infrared thoracoscopy (6) or virtual-assisted lung mapping (7) allow for a more precise identification of the intersegmental plane.

In their article of a unidirectional surgical approach, Zhu and colleagues have overcome the principle of evaluating and preparing the organ on which is to be operated from different directions and sites by choosing a unidirectional approach. The unidirectional approach has certainly advantages such as not torturing the lung by changing its positions multiple times. However, other maneuvers such as lymph node dissection from the station No. 7 still need to be performed from dorsally. Whether this unidirectional approach has the potential to become a standard procedure will be a matter of further evaluation by other experienced thoracic surgeon colleagues with their respective expertise.

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## Footnote

*Conflicts of Interest:* The author has no conflicts of interest to declare.

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